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ECONOMIC AND PHYSICAL GEOGRAPHY OF CHINA

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ECONOMIC AND PHYSICAL GEOGRAPHY OF CHINA

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## I. THE NATURAL GEOGRAPHY OF THE CHI-LIEN SHAN

Pages 399-402

Wei Wen-tse and  
Huang Ta-hsin

The Chi-lien Shan mountain area is located in the border region between Kansu and Tsinghai provinces, which is composed of a number of parallel high mountains and horizontal valleys. It starts at Chin-shan-kuo (sea level 3,519 meters) at  $34^{\circ}18'$  east latitude in the west, where it is linked together with A-erh-chin-shan, and ends at Sung-shan (sea level 2,668 meters) at the eastern end of Wu-hsiao-ling at  $103^{\circ}30'$  east latitude in the east. The total length of the mountain area is 900 kilometers. In its northern part is the large Nan-shan corridor, which includes Nan-shan in Tsinghai Province and Ha-mei-erh-shan in the neighborhood of Ta-tsai-tan. The width of the corridor is some 300 kilometers. The southern border of the corridor extends from Te-ling-ha, Cha-ka to Kuei-te in Tsinghai Province. The total land area of the corridor is more than 100,000 square kilometers. In the mountain area there are low valleys with sea levels of 2,000-4,000 meters as well as high peaks with sea levels of 4,000-6,000 meters. It has plain valley lands, deep valleys, large inland lakes such as Tsinghai and Ke-la-hu, a large number of glaciers, many well-known inland rivers and the large tributaries of Yellow River such as Huang-shui and Ta-tung-ho. Its climate is a sort of transitional one between the East Asian Monsoon climate and inland arid climate.

The Chi-lien-shan is also called by us as Wen-po-shan (Mountain of Numerous Treasures) because it contains very rich natural resources. Its mineral resources include iron, manganese, nickel, gold, silver, gas, coal, petroleum, and salt. It also has endless forests and water resources for generating power. It has large grazing lands for several million head of animals. Numerous wild beasts are found in the mountain area. All people who have taken trips to Chi-lien-shan not only marvel at its rich natural resources but also feel proud for the people in the northwestern part of the Motherland.

### A. Topography

The formation movement of Chi-lien-shan started in the Caledonian Era, folded back in the Variscian Era and finally became a high mountain after the Yen-shan and Himalayan Movements. During the Variscian period, it was infiltrated by neutral and acid eruptive rocks; the rock beds formed before the Devonian period were turned into the well-known Nan-shan deformed rocks; and the structural gaps have become more developed, making it one of the areas with more radical structural movement at the present. On the northern slope of the mountain, there are many fault beds which were formed from the

old structural lines. Earthquakes are quite frequent in the mountain area. In recent years, severe earthquakes had occurred in Sha-tan, Wu-wei and other areas. The earthquakes occurring in Chi-lien-shan are of eighth or ninth grade but are rapidly upgrading.

The mountain areas of Chi-lien are formed by many paralleled glaciers and glacial peaks have been developed in the mountain areas. Its valleys are mostly horizontal and are characterized by their width and vertical formation. The width of the valleys averages 10 kilometers and the length averages 100-200 kilometers. In certain areas, the valleys became mountain basins. The western part of Chi-lien-shan is divided by seven peaks and seven valleys with widths of 250-300 kilometers. The northern part is the Nan-shan corridor, which extends southward to the Chu-lung-kuan valley and finally to Tu-lai-shan and the Tu-lai valley. The Tu-lai Ho (River) is the upper stream of the Pei-tai Ho, which is the northwestern tributary of Eih-chi-na Ho. The Tu-lai Ho has a sea level of 3,500 meters and has wide river beds. Interrupted by beaches formed by the sands and pebbles from the river, the river runs into curves and forms many swamps, where the underground water is drained off. The terrace lands on the northern side of the river valley were formed by proluvia and those on the southern side were formed by the sedimentary deposits, which are wider than those on the northern side and has an etched hill called the "Wu-ko-shan" (Five Hills). Nan-shan extends from Tu-lai to the west to form the Ya-ma Shan (Wild Horse Mountain). Due to the strong elevation movement, the valleys are also deeper, the well-known ones including the "Wu-lan-ta-wu-kou" and the "Wu-ko-shan-kuo." Further to the south are the So-li-ho Valley and the So-li-nan-shan. In fact, So-li-nan-shan is the highest, widest and longest mountain area in Chi-lien-shan. The Ha-la-hu basin in the southern side of So-li-nan-shan which has an elevation of 4,100 meters, is the highest mountain basin in Chi-lien-shan. Still further to the south, the topography becomes moderate and the valleys become plainer.

The bottom of the shady slope of each mountain area is formed mainly by sedimentary deposits covered by layers of sands and mud which in turn, are covered by frozen layers on top of which are an ice eolian zone and a snow gathering zone. The glacier snow belt exists when the elevation reaches 4,500 meters. The corries above this elevation are mostly filled up by the modern glaciers. The conditions on the sunny slope of each mountain area are quite different. The piedmont is generally formed by proluvia and diluvia and the glacial sediments and geomorphology of sands and mud are not significant. The ice eolian zone is still commonly found, however. Glaciers and snow are seldom found on the sunny slope.

The eastern part of Chi-lien-shan is somewhat lower than the western part. The former also has fewer parallel valleys. There is a series of low hills around Chang-i and Shan-tan in the northern part, which are formed by the old rock beds. These old rock beds have been

cut by the river flow into numerous isolated hills such as the Yu-mu-shan (sea level 3,400 meters), Niu-mo-shan (sea level 3,300 meters) and Wu-tang-shan, etc. The high corridor Nan-shan is an erosion folding mountain, which is huge and has complicated topography and is cut through by several rivers, including the Li-yuan Ho, Chang-kan Ho, Su-yao Ho, to form valleys through which people enter the mountain area. Where the mountain is cut through by Hei Ho, there are formed the "nine large slopes" known for their sharpness. These slopes have preserved certain virgin forests and are ideal sites for building electric generating stations to irrigate the terrace lands. Farther to the south is the horizontal valley of Hei Ho, which is narrower; its average width is between 1 and 2 kilometers. There are three levels of terrace land along the river and the river valleys are sometimes wide and sometimes narrow mixed with a series of small basins like stringed-beads. Because they are not too high (for instance, the elevation in Huang-chuang-tsu is 2,600 meters), these terrace lands could be developed into irrigated farmlands. Still farther to the south is Tu-lai-nan-shan which is even wider and more level than the main range in its north. In the south of Tu-lai-nan-shan are the Ta-pan Shan, the Tsinghai Lake basin and the Tsinghai-nan-shan. The height of the eastern section of Chi-lien-shan is mostly less than 5,000 meters with fewer glaciers. But because of more rainfall, the river waterflow is much larger. Erosion is serious along this section and a number of mineral beds are exposed.

#### B. Climate

Because Chi-lien-shan is located in the west wind zone at the middle latitude and because the elevation is generally higher than 3,000 meters, the climate in the mountain area is greatly affected by the movement of the west wind. Although the area is situated in the nation's inland, it is close to the western side of the Middle Asia low pressure center in the summer and therefore the eastern part of the area could be reached by the monsoon. The corridor on the west bank of the river is the channel through which the cold wave hits the area from the northwest in the winter. Being affected by the corridor topography, the cold wave moves rapidly along the gaps in Chi-lien-shan (including the river valleys in Tang-ho, So-li-ho, Hei Ho and Pan-tao-kuo) and hits the inland horizontal valleys in the mountain areas. The cold wave is usually accompanied by small amounts of snow and rainfall. But between the cold waves, the low pressure trough often brings mild weather from Tibet to Chi-lien-shan area. After March, the temperature increases more rapidly; however due to the instability of the air, windstorms, sandstorms, and duststorms often hit the area. The eastern part of the mountain area is more significantly affected by the monsoon which results in more rainfall. The rainfall in the mountain area is also affected by the degrees of



elevation and by the cold waves in the summer. On the other hand, the northern side of the mountain area is often hit by the hot and dry wind which causes damage to agricultural production. After September, the mountain area is affected by the rising high pressure from Mongolia which results in more clear days.

The temperature in the Chi-lien-shan area is characterized by its variation and by the differences between the sunny and shady slopes. The temperature changes with elevation and the annual temperature variation decreases as elevation increases. For instance, at the Chi-lien-shan weather station which is located at an elevation of 2,240 metres, the average annual temperature is  $5.6^{\circ}\text{C}$  and the annual temperature variation is  $27.0^{\circ}\text{C}$ . The average temperature in Huang-chuang-tsu which has an elevation of 2,600 meters, is  $3.2^{\circ}\text{C}$  and the annual temperature variation is  $23.5^{\circ}\text{C}$ . It is worthwhile to note that Huang-chuang-tsu which is located at  $38^{\circ}$  north latitude has the same average annual temperature as Harbin which is located at  $45^{\circ}45'$  north latitude. However, the climate of the former is not as favorable to agricultural production as that of Harbin. The reason is that the latitude of Chi-lien-shan is lower than that of Harbin and therefore its daylight is not as long as Harbin's in the summer. The summer temperature in Chi-lien-shan is also not as high as that in Harbin (the average monthly temperature in July in Harbin is  $23.4^{\circ}\text{C}$  as against  $14.8^{\circ}\text{C}$  in Huang-chuang-tsu. (The difference is  $8.6^{\circ}\text{C}$ .) In Harbin there are 5 months each year when the average monthly temperature is higher than  $10^{\circ}\text{C}$ , as against 4 months in Huang-chuang-tsu. Under general conditions, agricultural production in the valleys in Chi-lien-shan is not too low but it is easily damaged by cold waves and sudden frosts. Located along the upper stream of Hei Ho, Huang-chuang-tsu produces surplus food year after year. But in the fall of 1956, the crops were seriously damaged by the early cold waves and frosts. Therefore, it will be necessary to improve the frost forecast methods and frost prevention measures in the area. At the same time, the planting of early ripening and cold resistant varieties should be promoted; the residents should be encouraged to store surplus food for emergencies; the growing of vegetables in hot-houses should be advocated to supply sufficient vegetables to the local residents and the cadres in the mountain areas.

In the mountain areas, the air is thin and radiates quickly. At the same time, the cold air in the mountain areas drifts downward and gathers together. As a result, cold waves hit the mountain areas even on summer mornings. For instance, the upstream area of So-li Ho had been hit consecutively by temperatures  $3^{\circ}\text{C}$  below zero in mid-August. Although the temperature is not too high in clear days, the sun radiation is extremely strong; it not only darkens the fact but also causes the skin to fall off.

The rainfall is more abundant in the southeastern part of the Chi-lien-shan area than in the northwestern part, and greater in the

mountain areas than in the lower areas. The rainfall in the eastern part of Chi-lien Shan is generally more than 300 to 500 millimeter. For instance, the rainfall is 520 millimeter in Wu-hsiao-ling and 650 millimeter in Chiao-tou-chen in Ta-tung in Tsinghai province. The rainfall in the higher mountain areas may even reach 700 millimeter. The rainfall in the western part of Chi-lien-shan is less than that in the eastern part because the summer wind can not reach the western part. Most areas in the western part have rainfall less than 200-300 millimeter. (The rainfall in Yu-chi-hung along the upstream area of So-li Ho was 242 millimeter in 1955 and 185 millimeter in Hua-chi-ti). In regard to seasonal distribution, rainfall inclines to concentrate in the summer. August is the month when rainfall is most abundant. The rainfall in August often accounts for more than one fourth of the total annual rainfall. At that time, the river water overflows; this handicaps communication and transportation. On the other hand, rainfall is urgently needed but insufficient in early summer in the western part of the river area and in the eastern part of Tsinghai to irrigate the crops. At present, there are many new cities being built around Chi-lien-shan and the older cities are expanding and increasing needs for water. Therefore, one of the major projects is to reserve the excessive August rainfall for consumption in the next spring and early summer. Presently, large dams are being built in Chang-chang-ma Gorge, Tu-lai Gorge and Hei Ho Gorge.

The weather in the mountain areas changes quickly and the weather of four seasons may be found in one day. For instance, in late July in 1956, the authors encountered evening windstorms in Ta-chuan-kou (elevation 3,000 meters) along the upstream of Pei-yang Ho in the south of Yu-man and the authors had to wear fur coats. In mid-August, when the authors were traveling along the upstream portion of So-li Ho (elevation 3,750 meters), one morning the towels and toothpaste carried by the authors were frozen. But a few hours later, the sun was shining brightly. By noon time, clear and cloudy weathers alternated mixed with rain, snow swirling wind and lightening. Another afternoon, it rained five times within 3 hours. By mid-August, the rainy season in Chi-lien Shan makes one to feel that he is not in the northwest but in the south of the Yangtze River.

In summary, the climate in Chi-lien Shan may be roughly divided into the eastern and western regions, separated by 99° east latitude. The climate in the western part is the dry mountain climate which produces very little rainfall; some snow falls in the winter. The average monthly temperature in July is less than 10°C, making it unfavorable for forest growth. Therefore, forest is not to be found in the western part of Chi-lien Shan except for small strips of shrubs. Prairies do exist in this part, however. Because snow mostly falls in the spring and summer, snow accumulates in the mountain top. The valleys in the eastern part of Chi-lien-shan have lower topography, milder climate, and more rainfall, and there forests flourish. In certain parts of the



valleys, farming is highly developed. Swamps are found along the rivers, in where the water grasses thrive. Because the temperature is higher, because the rainfall is concentrated in the summer, and because snowstorms are quite frequent, the climate in the eastern part of Chi-lien Shan is the semi-humid mountain climate. Because the mountain areas in the eastern part are not so high, the amount of glaciers and snow is less than in the western part.

### C. Water Resources

The rivers in the Chi-lien Shan area are controlled by its parallel ranges. Therefore, the valleys along the upstream areas of the rivers are mostly in horizontal directions; most are wider than 10 kilometers. The rivers mostly originate from the mountain peaks around Tu-tu-chang Mountain which is also known as the "Origin of Five Rivers." The rivers are mostly inland rivers. They include the river system along the corridor in the western part of the Yellow River drainage system, the Chai-ta-mu Basin river system, and the Ching-hai-hu River system. Of these systems, the rivers along the corridor in the western part of the Yellow River are most important. The rivers along the corridor, in turn, may be divided into three systems. The Shih-yang Ho system in the eastern part is composed of the rivers in Ku-neng, Wu-wei and Yung-chang-hsiens. The more important rivers are the Ku-neng Ho, Huang-yang Ho, Cha-mu Ho, Chin-ta Ho, Si-ying Ho, Tung-ta Ho and the like, which cover a total land area of some 11,000 square kilometers and whose annual volume of waterflow totals 2.8 billion cubic feet. In the central part, the Erh-chi-na Ho system is the largest river system in the western part of the Yellow River. Its land area includes Shan-tan, Chang-i, Chiu-chuan and Su-nan in Kansu Province and the larger part of Tsinghai Province, totaling some 30,000 square kilometers. The annual volume of waterflow of these rivers amounts to 4.3 billion cubic feet. The system is mainly composed of two rivers, namely, Hei Ho and Pei-ta Ho. These two rivers not only have large volumes of waterflow, but also run through the mountain area to form many valleys suitable to reserve the water. The melting glaciers and snow along the upstream portions of the rivers also augment the water volumes. The So-li Ho system in the western part is mainly composed of So-li Ho, Ta-mei Ho and Tang-ho, which are life veins of the cotton and food producing areas in An-si and Tun-huang. They cover a total land area of 38,000 square kilometers but have small volumes of waterflow which amount to only 1.6 billion cubic feet. The small volumes of waterflow (especially that of Tang Ho) can not supply the need of irrigation. Therefore, the local peasants had long ago devised methods to melt the glaciers and snow upstream to increase the volumes of waterflow.

The southwestern part of Chi-lien Shan area is the Chai-ta-mu Basin valley. The main rivers include the Ha-erh-teng-ko-li River which runs into Su-kan Hu, the Yu-ka Ho which runs into Ma-hai Hu and

the Pa-yin-ko-li Ho which gathers into the Ku-erh-lai-ke Hu. Although the volumes of waterflow of these rivers are not large, they are extremely important because they supply water to the residents in the newly-created cities such as Yu-ka, Ta-chai-tan and Te-ling-ha. In addition, there is the Tsinghai Hu river system. The main river of this system is the Bu-ha Ho, which has a total annual volume of waterflow of some one billion cubic feet, which flow into Huang-shui, and Ta-tung Ho, two of the tributaries of the Yellow River. This system covers a total land area of 34,000 square kilometers and the total annual volume of water flow of the whole river system is 4.8 billion cubic feet.

The supplementary sources of water for rivers in the eastern part of Chi-lien Shan include rainfall and melting snow. The farther west, the less important is rainfall as a supplementary source of river water. When it comes to Tang Ho, the major supplementary source of river flow is melting snow. The general tendency is that after March and April, the river flow gradually increases and finally turns into floods as snow begins to melt. From June to September, the combination of thunder showers and melting snow turns into torrents. After September and October, the river flow gradually declines. The first river to overflow is Tang Ho in the western part, which generally begins in March. The rivers in the eastern part of Chi-lien Shan do the same about one month later. But due to insufficient rainfall in the summer, the volumes of waterflow of the rivers in the western part of Chi-lien Shan begin to decrease in August. On the contrary, the rivers in the eastern part sometimes produce torrents as late as September.

It is estimated that the amount of glaciers in Chi-lien Shan totals some 40 billion cubic feet, which is ten times larger than the combined volume of the water flow of all rivers in the area. The glaciers could be used to regulate the river flow or could be melted by artificial means to meet the need for water supply.

At present, work has begun to investigate the reasonable utilization of the water resources and the possible reformation of the natural conditions. We are using artificial means to quicken the melting of the glaciers to increase water supply in the dry periods. Meanwhile, we use man-made rainfalls and build reservoirs at the gorges to conserve the water. The abundant underground water may be retained and pumped up to the surface in order to solve the water supply problem in the arid land areas around Chi-lien Shan.

#### D. Soil and Vegetation

Both the soil and vegetation in the Chi-lien Shan area are of the mountain types. In addition to the characteristic that they form vertical distributions as the elevation increases, the soil and vegetation types in the eastern part are different from those in the western part because the topography of Chi-lien Shan declines from west to east.

The general tendency is for the arid soil and vegetation types to develop gradually from east to west.

The soils in the area may be classified into seven types, namely, the calcareous soil, the mountain steppes, the mountain dark gray soil, the mountain forest soil, the mountain prairie soil, the marsh soil and alluvium. The rocks of these soils mostly contain calcium and therefore most soil types show carbonate reaction.

The calcareous soil is found in the northern slope of Chi-lien Shan and is linked together with the desert calcareous soil in the corridor in the western bank of the Yellow River. This soil type is distributed in places with elevation ranging from 2,210 to 2,400 meters in the eastern part of Chi-lien Shan and in those ranging from 2,500 to 3,100 meters in the western part. Due to the insufficient rainfall and to the dry climate, this type of soil contains very small amount of water. The cross-section of this soil type is not well developed and has thin layers. However, its chemical and weathering functions (mainly physical and weathering functions) and the melting sedimentation are still apparent. Therefore, layers of chalk mixed with limestone can be commonly found. During the dry seasons, the alkali element comes up from the soil and shows neutral and slight acid reactions. Sometimes, alkaline surfaces are formed. This type of soil is mostly distributed in the slightly inclined plains in where vegetation is sparse. The soil contains very little humus. In the lower land areas in where the reeds grow, this type of soil may contain more humus. The vegetation types grown on this soil are mostly of the desert prairie vegetation, including the drought-resistant shrubs and reeds. These types of vegetation are scattered on tops of the soils with very little scenic value.

The mountain dark gray soil is found in the eastern part of Chi-lien Shan, mostly on the shady slopes with elevation from 2,400 to 2,500 meters. This soil type is of the low hill shrub type. Due to higher elevation and rising humidity, the vegetation in this kind of soil consists mostly of shrubs such as wild roses, aspen (*Lysium chinense*), catalpa and the like. These plants thrive well to heights of 1 to 1.5 meters. The ground vegetation under these plants is mostly moss. Because of this kind of ground vegetation, the soil is covered by a thin layer of decaying material which contains rich humus. The resulting topsoil has a dark gray color. In the cross-section of this type of soil, the brownish calcareous layer shows strong alkaline reaction and the other layers all show neutral or slight alkaline reactions.

The mountain forest soil is developed in the fir forest area and is found only in the eastern part of Chi-lien Shan. This is because along the upstream portions of So-li and Tu-lai rivers in the west of Hung-hai-tsu, the elevation is high, usually above 3,500 meters, and the upper limit of forest distribution is on areas with elevation of 3,000 meters in the eastern part. In the western part, the valleys are parallel to the rivers; the direction of the strong winds which sweep

over this part of the area causes strong evaporation. Moreover, the western part is closer to the inland center where rainfall is less abundant and the humidity is unfavorable to the growth of tall trees. Therefore, the steppes take the place of forests in the western part. Fir trees grow on the forest soil in the eastern part of Chi-lien Shan, usually on the shady slopes at elevations of 2,600 to 3,200 meters. This area is part of the coniferous tree zone in the Chi-lien Shan area. The area above the fir tree zone is the coniferous tree zone dominated by juniperus. Under these tall trees, there is very little vegetation and the decaying layer on the ground is not very thick; it is usually covered by mosses.

The mountain prairie soil is widely distributed. This type of soil is found on the sunny slopes at elevations of 2,600 to 3,200 meters in the eastern part and at elevation of 3,100 to 4,000 meters in the western part. This type of soil is dominated by the chestnut calcareous soil. The type of vegetation on the mountain steppe soil is the subalpine steppe vegetation, which is found on the sunny slopes at elevations of 2,600 to 3,000 meters in the eastern part of Chin-lien Shan and at elevations of 3,200 to 4,450 meters in the western part. These areas are the most valuable grazing lands in Chi-lien Shan. The composition of the vegetation varies with the elevation. On the sunny slopes at elevations of 2,600 to 3,200 meters in the eastern part, the principal vegetation includes rushes, boxwood and other shrubs. On the slopes at elevations above 3,200 meters, there are grain steppes, which are mainly composed of glacial grasses, purple-floral rushes, long-needle rushes, mucilaginous grasses, early ripening rice and the like.

The mountain steppe soil is found in areas at elevations above 3,200 meters in the eastern part and on the shady slopes at elevations above 3,200 meters in the western part. The lower boundary of this type of soil is linked with mountain forest soil and the mountain prairie soil. Due to high elevation, low temperature, and severe cold weather, this type of soil is subject to serious freezing and weathering actions. Moreover, the areas where this type of soil is located have abundant rainfall in the summer, and accumulate snow in the winter which melts in the spring. Consequently, the soil is wet the year around; this results in the difficult dissolution of the organic matter and the accumulation of carbonate clay in the soil. At present, the vegetation on this type of soil is the subalpine and alpine steppe zone type. Tall trees are found in the high mountains at elevations of 3,200 to 3,800 meters in the eastern part but disappear in the western part. The important shrubs include willows, polygonum, gentian, and early ripening rice. Shrubs are few in the areas above this zone; the important ones are rushes, gentian, aconite, sedum and the like. These plants are also the typical vegetations in the shrub steppes in the eastern part and in the subalpine and alpine steppes in the western part.



The marsh soil is mostly found in the low lands on top of the mountain area and in the valley lands. Because the lower lands on top of the mountain are often dry, the aristemia, sedge, and the like grow there. The lower lands in the river valleys are mostly filled up with water, where aristemia and water wheat also thrive.

Alluvial soil is mostly found on the piedmont, on the terrace lands along the river banks, and on the beaches. On the alluvial soil of the beaches there grow willows and cypress; on the piedmont and terrace lands, vegetation of the grain family flourishes.

The pebble region and the glacial zone are found at elevations above 4,000 meters where vegetation other than mosses is rare.

#### E. Wild Animals

Chi-lien Shan has numerous wild animals, most of them mammalia. The important wild animal in the valley prairies in the western part Chi-lien Shan is the equus hemionus, generally known as wild horse. Groups of hundreds of wild horses can be found along the north bank of Pei-ta Ho. They run fast and are difficult to catch. Another important kind of wild animal is the procapra picticauda, commonly called the Tibetan yellow goats, which are different from the common yellow goats (procapra gutturosa) found outside of Chi-lien Shan. The Tibetan yellow goats are locally called as the "bottom-up goats" because they raise up their tails and expose the white fur under their tails when they run. Green goats, or pscudois nahura, feed on the slopes or on the piedmont but are also found on the rocky mountains. A green goat, shot by the authors at Wu-lan-ta-wu-kue, weighted more than one hundred catties and was quite tasteful. Other wild animals in Chi-lien Shan include the wild buffalo (poephagus grumicus) and big-head goats (ovis ammon). Wild buffalo are extremely alert and therefore are difficult to hunt down. The brown bear (ursus arctos), Mongolian rabbit (lepus tocai), and Kansu cervus elaphus are also found in abundance. The Mongolian rabbits usually live on the shrubs and in the rocky caves. The cervus elaphus live along the upstream river areas where willows grow. The number of cervus elaphus has declined significantly because they were hunted down for use as medicine. Therefore, measures should be taken to raise this kind of wild animal. Among the small wild animals, marmota himalayana and several kinds of ochotana (Ochotana tibetana, ochotana dahurica, and ochotana macrotis) are numerous. The marmota himalaya, commonly known as Ha-la, mostly lives in the grassy shady slopes. It is harmful but is also an important fur-producing animal. Its flesh is edible and it produces large amount of fat. The marmonta himalaya fur accounts for 60-80% of the total amount of fur purchased in this area. Therefore, large-scale hunting of this kind of animal not only eliminates its harmful effect but also gives us more fur. The ochotanas, commonly called crying rabbits or tail-less rabbits are most harmful to the grazing land. They dig holes in the grazing lands,



harming the soil structure and the growth of grasses. Measures should be taken to hunt them down in large number. The eagle is the greatest enemy of the ochotanas and the Tibetan osprey is their best friend.

The types of animals in the eastern part of Chi-lien Shan are similar to those found in the western part. But in the forest areas in the eastern part, there are many wild animals, including the martes foina, which produce valuable furs. The martes foina in Chi-lien Shan, commonly known as snow-sweeping animal, is different from the wild animal with the same name found in Northeast China. The former is most active at night time and difficult to hunt, but it produces very valuable fur. Other fur-producing animals include the felis lynx, mustela altaica, vupes vulpes, felis bangalensis, meles meles, ursus pruinosa and ursus arctos. The ursus is numerous in the Hung-ta-pan area which is located in between the Ta-chang-kan Ho and the Hsiao-chang-kan Ho, in where many people have been hurt by this kind of wild animal. According to the historical records, there is a kind of wild animal called snow leopard which also produces excellent fur. It has never been hunted down and therefore no detail is available.

A certain part of Chi-lien Shan could be set aside as an animal reservation area, in which hunting of valuable animals should be prohibited and some of the animals may be tamed for propagation.

In summary, Chi-lien Shan is a mountain area with complex topography, varried climatic conditions, many types of soil and vegetation and abundant glacial and water resources. These natural conditions are favorable to the increase of grazing lands in the mountain area, to the growth of forests, and to solving the water supply problem in the corridor west of the Yellow River. Recently, many mineral reserves have been discovered in the Chi-lien Shan area; they could be used as natural resources for developing the industries in Kansu and Chinghai Provinces. The development of the natural resources in this mountain area, which has long been neglected, can play a more important role in the Socialist reconstruction in our country.

## II. RIVERS AND WATER POWER SOURCES OF FUKIEN

Pages 410-412

Hu Shan-mei

### A. General Features of the Rivers in Fukien

1. Abundant Water Flow. Being one of the rainy areas in China, the annual rainfall in Fukien ranges from 1,500 to 2,000 millimeters. The rate of evaporation, however, is smaller in Fukien than in other areas in North China and a large portion of the rainfall becomes surface overflow which increases the rivers' water volumes. For instance, Min-chiang ranks eleventh among the nation's rivers in terms of territory covered, but ranks seventh in terms of volume of waterflow. The volume of waterflow of the Yellow River is only three-fourths that of Min-chiang, although the territory covered by the former is 12 times bigger than that covered by the latter. Even the volume of waterflow in a small river in Fukien is larger than that of a larger river in North China. Therefore, the rivers in Fukien are "short but fat."

Mountains and hills account for 95 per cent of the land area in Fukien Province, on which volcanic rock beds with poor drainage are exposed. Because the topography is sharp in these areas, rain often produces abundant surface overflow. The median of run-off of the rivers averages 40 second-liters (For instance, the median of run-off is 41.68 second-liters in Min-chiang, 44.89 second-liters in Chin-chiang, and 37.49 second-liters in Chiu-lung-chiang) which is larger than the medians of run-off of many larger rivers in China (The median of run-off is 1.98 second-liters in the Yellow River, 17.14 second-liters in the Yangtze River, and 25.90 second-liters in the Pearl River). The median of run-off is especially high in the mountain area, such as Yuan-chien-chi, along the upstream of Min-chiang, which is often more than 50 second-liter (it reaches as high as 54.2 second-liter in areas above Hung-mei), making it the area with one of the highest run-off medians in our country.

2. Wide Fluctuations in the Volumes of River Flow. The changes between the average annual volumes of water flow of the rivers in Fukien are not too large. According to the observations made from 1950-1954, the ratio of water volume in the highest year in Min-chiang to that in the lowest year was 1:1.25. The seasonal fluctuations of the river water volumes, however, are great; this is characteristic of the rivers in the monsoon areas. For instance, in 1953, the largest water volume in Chin-chiang was 2,370 second-cubic feet and the smallest, 17 second-cubic feet. The largest water volume in Chang-chi (the largest tributary along the lower stream of Min-chiang) was 3,660 second-cubic feet, and the smallest was 11.8 second-cubic feet. In 1952, the largest water volume in Ku-tien-chi (a tributary in the middle stream of Min-chiang) was 4,200 second-cubic feet and the smallest 5.1

second-cubic feet. It is seen, therefore, that the annual ratios of the water flow of the rivers in Fukien are high, generally above 100 (with the exception of the ratios of the rivers along the upstream portion of Min-chiang), which is higher than the ratio for the Yang-tze River (1:10).

The main reason for the wide fluctuation of the river water volumes is that 40-40 per cent of the annual rainfall is concentrated in April, May and June. During these months, the water volumes of the rivers are the largest and their water levels are the highest. After the passing of the summer overflow, the province is hit by typhoon (from July through September) during which the second peak overflow occurs. During the period from March to September every year, the river water volumes are the largest and during the period from October to February, they level off. The river water volumes in the first period account for 80-85 per cent of the annual volumes. Therefore, the ratio of the average volume of water flow in the month with the largest river water volume to that in the month with the smallest river water volume generally ranges from 5 to 12. In the areas seriously affected by typhoon, the river water volumes fluctuate according to the times the areas are hit by the typhoon, their velocity and their duration.

3. Small Volume of Sand Content. Forests, which thrive in the mountain areas in Fukien Province, conserve the soil. As a result, the rivers in the province contain only small volumes of sand. For instance, the annual volume of sand content in Chin-chiang, which holds more sand than any other river in the Province, is 0.34 liter per cubic foot of water. Even in the flood period, the sand content is not more than 2 liters. We all know that the sand content in the Yellow River may reach as high as 575 liters and not less than 10-15 liters even in the dry period. In regard to the volume of sand carried by the rivers in Fukien Province, Min-chiang carries 8 million tons of sand in an average year; this is nine times the sand volume carried by Chiu-lung-chiang and four times that carried by Chin-chiang. But the sand volume carried by Sen-shui, a tributary of the Yellow River, which covers only one-fourth of the territory of Min-chiang, reaches 14 million tons per year on the average, or 1.75 times that carried by Min-chiang.

4. The Great Water Systems. The mountain ranges in Fukien mostly run from NNE to SSW, which are nearly parallel to the coast line. The major mountain ranges may be divided into two groups. One group is the Wu-li Shan range in western Fukien which runs along the borders of Fukien and Kiangsi Provinces. Another group is the Tsao-feng-Tsaiyun-Poping range in eastern Fukien. The average height of these mountains is 1,200 meters and they stretch more than 500 kilometers. The directions of the major structures of the rivers and mountain ranges (NNE-SSW, and NNW-SSE) are almost identical. The main tributaries are parallel to the mountain ranges, or run through the mountains to intersect vertically with the main courses, and form great water systems.

## B. The Major Rivers in Fukien

The major rivers in Fukien include Min-chiang, Chiu-lung-chiang, Chin-chiang and Ting-chiang, which form 29 water systems, consisting of 663 rivers of all sizes and totaling 12,850 kilometers. The annual water volume poured into the sea from these rivers totals 130,000,000,000 cubic feet.

1. Min-chiang. Min-chiang is the largest river in the province and in the southeastern coast of China. It is 577 kilometers long and the territory it drains accounts for more than 50 per cent of the land area in the province. The average volume of river flow is 2,079 second-cubic feet or 4 times that in Chiu-lung-chiang and Chin-chiang, or one-half of the total volume of waterflow of all rivers in the province.

Upstream, Min-chiang has three tributary systems: the north, central and south tributaries. The northern system consists of three tributaries, i.e., the Nan-po-chi which originates from the north of Po-cheng, the Sung-chi which originates from the west of Sung-an, and the Tung-chi which originates from the north of Sung-chi. These three tributaries gather together at Chien-au and is then called Chien-chi. The central origin is the Fu-tun-chi which originates from Shan-ling in the west of Kuang-chih, and intersects with Chin-chi at Sun-chang. The southern tributary system is Sha-chi. The origin of Sha-chi is Chiu-lung-chi which rises west of Ning-hua, receives more water from the tributaries along the way, and finally enlarges at Yung-an. These three tributary systems join at Nan-ping. Of these three, the average flow volume of Chien-chi is the largest, followed by Fu-tun-chi and Sha-chi. These three tributaries cover a total land area of 41,900 square kilometers, or 72 per cent of the total territory of Min-chiang. About 81 per cent of the water volume of Min-chiang is gathered from these three tributaries.

These three tributaries of Min-chiang all originate from Wu-Shan which has an elevation of 1,000 meters and then suddenly drops to 70 meters at Nan-ping. The sharp drop of the river bed produces many rapids. As the local residents describe it, "there is a rapid in every 10 feet and Hsao-wu is as high as heaven."

The section from Nan-ping to Shiu-chi-kuo, which is called Chien-chi, receives water from Yu-chi at Chang-pan-hu and from Ku-tien-chi at Shiu-kuo. The water volumes of and the territories covered by Yu-chi and Ku-tien-chi are both smaller than those of the three tributaries along the upstream portion of Min-chiang. The average annual flow volume of Yu-chi is 156.5 second-cubic feet, and that of Ku-tien-chi is only 46.8 second-cubic feet. 14 percent of the water volume of Min-chiang comes from these three tributaries. The slope of the river bed in this section is somewhat more moderate than upstream, but there are still many rapids all along the way; among them the Ching-kou Rapid and the Chien-tao Rapid are well known.

The name Min-chiang is used from Shiu-kou on down. The river is still running from northwest to southeast and it gradually expands. It is divided at Nan-tai-tao in the neighborhood of Foochow into two branches, namely, the Nan-kon (Wu-lung-chiang) and Pei-kong (Ma-tou-chiang). These two branches run into the Foochow basin and join at Lo-sing-ta after they leave the basin. These two branches are shallower and their width varies in different places. The widest section may reach 2,000 meters and the narrowest section in Hung-shan-chiao in Pei-kong and in Hsa-tuo valley in Nan-kong measures only 300 meters. The water volume of Nan-kong is larger than that of Pei-kong. The former also receives water from Ta-chang-chi (Sheng-chi).

From Ma-mei on down, Min-chiang suddenly narrows down and divides into two branches by Nang-chi-tao in the neighborhood of Kuan-tou. These two branches (the south branch, also called Tan-tou-chiang, and the north branch, also called Chin-mon-pai,) enter the sea separately. The south branch is wider but shallower and the north branch is narrower but deeper. Boats enter and leave the river mostly through the north branch.

2. Chiu-lung-chiang. Chiu-lung-chiang is the second largest river in Fukien, which is 258 kilometers long and covers a territory of 13,000 square kilometers. It has two tributary systems. The southern system, called Yen-shih-chi, rises in Lung-yen. The northern system called Chiu-pang-chi, rises in Ning-yang. These two join at Chang-ping, from which the river runs southeastward through Lung-chi, receives water from Lung-chiang in the west, passes through the port of Amoy in the neighborhood of Shih-ma and enters the sea. The total annual rainfall of the territories drained by Chiu-lung-chiang averages 1,600 to 1,800 millimeters, which is smaller than those along the territories drained by either Min-chiang or Chin-chiang. The former's run-off median is also smaller and measures only 34.38 second-liter square kilometers. (above Po-nan). Nevertheless, the flood volume of Chiu-lung-chiang may reach 5,000 second-cubic feet. In normal years, the average annual flow volume at the outlet of the river is 447 second-cubic feet, indicating that the river's water volume is rather abundant. The river becomes wider at the lower stream which is accessible to the passenger junks and steamboats of 30-40 tons.



TABLE 1

COMPARISON OF THE THREE RIVERS ALONG THE UPPER COURSE OF MIN-CHIANG  
(Based on the observations in 1952-1953)

Name of River	Location of Observation Station	Territory covered (sq. km.)	Average Annual Waterflow (second-cu. ft.)	Run-off Median (liter-second-sq. km.)	Total annual runoff volume (million cu. ft.)
Chien-chi	Chien-au	16,500	703	46.86	221.66
Fu-tun-chi	Yang-kuo	12,000	563	46.91	177.52
Sha-chi	Ching-chou	13,400	460	34.32	145.03

3. Chin-chiang. Chi-chiang is 162 kilometers long and covers a territory of 5,140 square kilometers. It is one of the largest rivers in southern Fukien. The upper origin comes from the East and West Rivers. The East River originates in the western part of Yung-chun, passes through the county seat of Yung-chun and intersects with the West River at Shang-chi-kuo at Nan-an. The West River originates in the northwestern part of An-chi, passes through the county seat of An-chi Hsien and intersects with the East River at Shang-chi-kuo. After these two rivers join, the river volume increases and the width of the river surface expands. The river then runs along eastward for about 27 kilometers to pass through the township of Chin-chiang and enters the sea at Chuan-chou-wan. Because the upper stream of Chin-chiang originates on the sunny slope of Tai-yun Shan, it receives abundant rainfall (about 2,000 millimeters per annum) and the effect of typhoon is apparent. As a result, the river receives more rainfall than Min-chiang. During the typhoon season, the flood peak may be higher than in the monsoon season. The average annual river flow of Chin-chiang is 197 second-cubic foot. The vegetation of the Chin-chiang territory has long been affected by serious erosion. Although the total annual volume of sand carried by Chin-chiang is smaller than that carried by Min-chiang, the average sand content of the former is about 2.6 times of that of the latter and 4.8 times of that of Chiu-lung-chiang. The sand content of Chin-chiang is highest among all the rivers in Fukien.

4. Ting-chiang. Ting-chiang originates in the northern mountain area in Chang-tung, passes through the county seat of Chang-ting Hsien, receives the waters from Chu-chi, Te-tien-chi and former Hsien-chi along the way and rolls along the Shang-hand, receives the water from Huang-tan-chi and runs along the Feng-shih, receives the water from Yung-ting-chi and enters into Ta-po Hsien in

Kwangtung Province, and finally receives the water of Mei-chiang and enters into the sea. The length of the river within Fukien Province is 185.5 kilometers and covers a territory of 8,990 square kilometers. It ranks next only to Min-chiang and Chiu-lung-chiang and is the largest river in southwestern Fukien. The tributaries of Ting-chiang mostly originate in Shan-ling and in the deep valleys in the Po-ping mountain range, which has abundant rainfall and flourishing forests to conserve the water. Therefore, the water volume around Shang-hang remains at 30-40 second-cubic feet even when the river flow levels off. However, there are many dangerous rapids along the course and the water runs down swiftly. For instance, in the 60-kilometer section from Shang-hang to Feng-shih, there are more than 20 rapids, the largest ones being the Ta-ku-tan, Chuan-chin-tan, Che-tan and Pai-sha-tan. The distance between the highest and the lowest points of these rapids often comes to 3 meters. In the 5.5 kilometer section from Feng-shih to Shih-hsia-pa in Ta-pu Hsien, there are many sharp cliffs along both sides of the river. The river narrows down to 4 to 5 meters which greatly quickens the tempo of the water flow. The most dangerous rapids include the Chu-kao-tan, Lung-kou-tan, Kuai-kua-tan, Men-hua-tan and Chi-mu-hu. The differences between the highest points and the lowest points of these rapids are more than 3 to 4 meters on the average, making them inaccessible to boats. The hydraulic power of these typical mountain rivers ranks next only to that of Min-chiang in Fukien.

TABLE 2

RIVER RUN-OFF VOLUMES IN FUKIEN

Name of River	Length of River (km.)	Territory Covered (sq. km.)	Average Flow Volume (second-cu. ft)	Run-off Median (second-liter-sq. km.)	Total Volume of Run-off (million cu. ft.)
Min-chiang	577	60,800	2,079	34.10	772
Chiu-lung-chiang	258	13,000	447	34.38	143.96
Chin-chiang	162	5,140	197	38.30	62.06
Ting-chiang	185.5	8,900	281	24.25	--
Other Rivers along the coast in Southern Fukien	--	14,500	464	32.00	146.16
Other rivers along the coast in Northern Fukien	--	14,800	507	36.00	159.71

### C. The Development and Utilization of Water Power

The abundant water power of the rivers in Fukien is capable of generating 5,580,000 kilowatts of electricity, which is higher than the water power in other provinces in East China and is more than double the water power in Britain. In order to meet the need of agricultural and industrial development, a policy has been adopted which makes hydroelectric development the major construction project supplemented by fuel-generated electrical projects. The more important hydroelectrical projects which are being built or are planned include:

1. Ku-tien-chi Hydroelectric Station. Ku-tien-chi is one of the largest tributaries on the left bank along the middle course of Min-chiang, which originates from the mountain area in the west of Ping-nan, passes through Ku-tien, Min-ching and gathers into Min-chiang at Shui-kuo. The river is 110 kilometers long and covers a territory of 1,780 square kilometers. The section from Kuei-lai in the south of the ancient county seat of Ku-tien Hsien to Tang-tao gorge is a sharp river course of 300 meters from the highest point to the lowest point, thus making it an ideal site for building a hydroelectric station. The construction project has four levels and the total capacities of the four power stations amount to 256,000 kilowatts. The first-phase construction of the first level was completed at the end of 1956 and has delivered electricity to Foochow, Ping-nan and other places. The main construction of the second-phase of the first level is to build a cement dam 58 meters high, which would greatly raise the water level of Ku-tien-chi. This will make the low land in the ancient Ku-tien county seat into an artificial lake that will have a total capacity of 570,000,000 cubic feet. The water running down from the upper course of the river will thus be conserved for the benefit of the people. The second-level construction is the building of a dam 208 meters long and 40 meters high. Construction of all levels is in progress and the fourth-level construction will begin in the third quarter of 1959. To meet the need for the big leaps forward in agricultural and industrial production in Fukien, the Ku-tien-chi hydroelectric station is designated as one of the three key projects in the province.

2. Chien-chi Hydroelectric Station. This station will be built at the suburb of Nan-ping City along the lower course of Chien-chi. There are sharp cliffs on both banks at this site. A dam will be built to form a large reservoir that covers a territory of 6,000 square kilometers (or double the size of Tai-hu) and conserves 400,000,000,000 cubic feet of water. It will be capable of generating 1,680,000 kilowatts of electricity. At present, the survey work of the station is near completion and construction will soon begin.

3. Min-chiang Hydroelectric Station. This station will be built at Shui-kuo along the middle course of Min-chiang which will

be able to generate 2,000,000 kilowatts of electricity or three times the capacity of the well-known Hsin-an-chiang Hydroelectric Station in Chekiang Province.

4. Ting-chiang Hydroelectric Station. This station will be the center of the electrical system in southern Fukien and will be capable of generating 600,000 kilowatts of electricity. This project is presently in the planning stage.

In addition, other medium-sized and small hydroelectric stations will be built at Lu-hsa-pa in Yung-ting, at Chao-chi in Foo-an, at Ta-mu-chi in Foochow, at Chiu-li-hu in Shan-yiu, at Yen-shih in Lung-yen and at Nan-cheng in Lung-chi. The combined capacities of these stations amount to more than 200,000 kilowatts. These projects are being built or are planned.

Furthermore, more than 1,500 rural electrical stations have been completed in the past year; they generate 1,634 kilowatts of electricity. In Yung-chun Hsien, known all over the nation for the number of rural electrical stations it has built, over 60% of food processing has been done electrically. This shows the cities and rural areas the beautiful prospect of electrification.

Hereafter, the goal will be the construction of large-scale hydroelectric stations, which will connect the electrical system in southern Fukien with that in northern Fukien through the 1,900-kilometer high-pressure transmission lines to form a provincial electrical network with the medium-sized and small electric stations all over the province. Not only will this vast network supply electricity to meet the need for agricultural and industrial production and for lighting purpose, but it will also deliver electricity to Shanghai and other provinces in East China. By that time, the mountain areas with vast reserves of natural resources in Fukien will become the bases for the development of steel and iron industry, metallurgical industry, chemical industry and lumber industry.

The development of the water resources in Fukien will be carried out in accordance with the principle of over-all planning and coordinated utilization, under which projects of generating electricity, irrigation, flood prevention, navigation and marine production will be undertaken. For instance, the construction of the Chien-chi dam will not only produce electricity, but it will also conserve some one billion cubic feet of mountain water to eliminate the threat of flood to the areas along the lower course of Min-chiang and to regulate the water level of Min-chiang to facilitate navigation. In the past, Chien-chi had many rapids and the shallow water was accessible only to the small junks. Presently, boats of 5,000 tons can sail from Nan-ping upward to the piedmont of Wu-i Shan along Chien-chi. In this big leap forward era, the people of Fukien are doing the things that have never been done before to make a greater contribution to the nation's socialist reconstruction.

### III. DESERTS IN THE NORTHWEST

Pages 413-414

Lou Tung-mao

#### A. The Distribution of the Deserts

One third of the 9,600,000 square kilometers of land area in our country is arid land; 11% of the arid land, in turn, is desert. The total acreage of desert lands number some 1.6 billion mou. A large portion is located in the six provinces in the Northwest. The important deserts include:

1. The Yueh-erh-to-she Desert. The Mao-wu-su sand belt is located in the southeastern part of the plateau and the Ku-pu-chi Desert in the northern part of the plateau. The area totals 33,774 square kilometers (including the 13,774 square kilometers in northern Shensi).
2. The A-la-shan Desert. The desert is located in the A-la-shan Banner and the Erh-chi-na Banner in the west of Ho-lan Shan, in which many ancient rock beds had been depleted to become low mountains and hills. Between the low mountains and hills, there are pebble basins and large sand basins, which form the Pa-tan-chi-lin and Tseng-ke-li Deserts. The drift-sand areas total 36,000 square kilometers. In the Ma-sung Shan area in the west of Yueh-shui, there also exists stone deserts formed by broken rocks. The land area of the stone deserts total 90,000 square kilometers.
3. Ta-li-mu Desert. The desert is located in the southern part of Sinkiang, which is also called Ta-ke-la-ma-kan Desert or Great Gobi Desert which measures 1,000 kilometers from west to east and 400 kilometers from south to north. Located in the south of the desert is Kun-lun Shan and in the north is Tien Shan. Since the desert is surrounded by mountains, the climate is very dry and the pebble hills are huge and high. The details of the desert conditions are still unknown. The portions of the desert in the east of Lo-pu-pa are known as Pai-lung Desert and the Ha-shun Desert which are comparatively small and are easier to pass through.
4. The Chin-ko-erh Desert. The desert is located in the northern part of Sinkiang. A large portion is situated in the areas east of Ma-na-she River and in areas southwest of Wu-chuang-ku River. The latter portions are called as Ku-erh-pan-tung-ku-te Desert; the size is less than one fourteenth that of the Ta-li-mu Desert. The annual rainfall in the former measures more than 100 millimeters which is more than that in the Ta-li-mu Desert.
5. Chai-ta-mu Desert. The desert is located in the area between Ko-erh-mu and Meng-ai in the west of the Chai-ta-mu basin. Located in its north is the A-erh-chin Shan (in the west of Chi-lien Shan) and in the south is the Kun-lun Shan. Being surrounded by high



mountains in all sides and depressed in the center, the desert has an extremely dry climate.

6. Hsiao-tseng-ke-li Desert. The desert is located within the Shih-lin-ko-lih Banner in the Inner Mongolia Autonomous Region. Its boundaries are Lin-si and west of Cheng-peng along the upper course of Si-la-mu-chuang River, the north of To-chuang, the south of Pei-tse-miu and east of Pang Chiang. It measures 200 kilometers from east to west and about the same distance from south to north.

#### B. The Formation of the Deserts

The deserts in the northwest country are linked together with Central Asia Desert in the Soviet Union and the Gobi Desert in Mongolia. They are located in the same latitudes ( $15^{\circ}$  to  $35^{\circ}$  north latitude) as the Asia Minor Desert, Arabia Desert and the Sahara Desert in North Africa. In terms of air circulation, the areas within these latitudes belong to the high pressure zone in the northern hemisphere. The climate in these areas is steady; the air is dry and the rainfall is not abundant. This makes them become deserts. The areas within these latitudes, however, are not all deserts. For instance, in the southeastern part of our country, the climate is mild, and the air is humid; agricultural products flourish there. Deserts appear only in the northwest of China. The western part of the European continent which is close to the Atlantic Ocean, also has plentiful rainfall. Inland sea, salt sea and desert are not to be found until one reaches Central Asia. Therefore, other than the influence of latitude, the formation of the deserts is also influenced by the distribution of land and sea. In places distant from the ocean, moisture in the air is insufficient; this leads to the formation of deserts. Moreover, the formation of deserts is also closely related to topography. The northwest is surrounded by the Sikiang and Tibet plateaus, Chin-ling, Lu-pan Shan and T i-heng Shan. Since moist air enters this surrounded area with difficulty, it tends to increase the dryness of the area. The distribution of deserts in the inlands of Asia is much wider than that in areas with similar latitudes in North Africa and North America. Many deserts in the inland regions of Asia are often located in areas outside of  $40^{\circ}$  north latitude.

#### C. The Origin of the Deserts

Deserts are generally characterized by dryness. The annual rainfall in the deserts is usually less than 250 millimeters and may be as little as 75 millimeters. Moreover, the deserts are generally covered with endless driftsands and pebbles.

Sand originates from the weathering of rocks, from the alluvia of the ancient rivers, from the seasonal flood sedimentary deposits in modern times and from wind depletion. Being subjected to the alternative changes of cold and heat and the melting of the snow, rocks

are broken up into small pieces, which are gathered together by the force of wind and the seasonal flood flow into thick sand layers. The sand hills formed by the weathered materials in the Tertiary era, in the Jurassic era, and in the Cretaceous era in Yueh-erh-to-she and in A-la-sha are the products of weathering rocks which are gathered together by the force of wind. Large volumes of sand have been brought down to the areas along the lower courses or depressed lands by the ancient rivers or by the permanently or periodically flowing rivers, or by run-off. These loose sands, together with the alluvia of loam soils and lake sediments are the sources of the great sand deserts. Having been subjected to the blowing and depletion of wind, they become drift sands. In certain areas, overgrazing, overlogging and over-reclamation tend to destroy the vegetation which stabilizes the soil; this results in drift sands. For instance, the desert in Chien-tan-chao in the north of Yueh-erh-to-she and the Ma-wu-su desert in its south are the results of overgrazing by the old society.

#### D. The Harmful Effects of Deserts and Sand Controlling Measures

The movement of the sand hills often causes damage to agricultural production and to the population concentration points. For instance, more than 20 villages and 20,000 mou of farmland in Min-chun, Lao-cheng and Nan-po have been buried by the sands in the last 200 years. Only a few villages including Hua-yuan-kou and Hua-yin-kou and some 3,000 mou of farmland remain. Before measures of enclosing the sands and raising grasses taken in Teng-kuo, more than 1,000 mou of farmland were buried by the sands every year. The southward movement of the sand hills in the Mao-wu-su sand belt in northern Shensi forced the county seat of Yu-lin to move three times. All this indicates that sand deserts cause great damage to the national economy. For the construction of the socialist and communist societies, and to improve the peoples' livelihood, it is extremely important to take urgent measures to improve and to control the sand deserts.

The people in the Northwest, under the leadership of the party and the government since liberation, have taken great efforts to fight the sand storms and have made significant achievements in controlling the sand deserts. The measures taken include:

1. Biological Measures. Biological measures include afforestation, grass-growing, and sand-enclosing for growing grasses and planting trees to stabilize the sand hills. In certain places in the deserts, some vegetation does exist, which, if not ruined by humans and animals, can continue to grow and to prevent the movement of the drift-sands. There is a huge sand beach of 300 kilometers long and 20 kilometers wide in the south of So-li Ho in An-si in Kansu Province, which has been enclosed for several years and red willows and poplars are flourishing there. Its vegetation coverage rate has increased from 10% to 50%. Since it has been enclosed for growing grasses, one-half of

the 2 million mou sand desert in Teng-kuo in Inner Mongolia has become stabilized or semi-stabilized sand hills and gives protection to the vast prairie in the northeast of the A-la-shan banner, thus greatly benefiting the development of animal husbandry there. The best result of enclosing work has been registered in Lu-pa in Min-chun, Kansu Province. The enclosed desert is 40 kilometers long and 10 kilometers wide at its widest section. Within the enclosed area, red willows have grown as tall as 1.5 meters to become the longest green Great Wall against the sandstorms.

The establishment of shelter forests is the most important measure against the wind and for stabilizing the sands. Shelter forests could be planted along the borders of the deserts; along the river courses, ditches and channels; along the sides of highways and roads; and around the farm lands to stabilize the sands and to protect the farm crops. Beginning in 1957, a shelter forest belt 11 kilometers wide and 14 kilometers long was planted by the Hsueh-pa Forestry Station in Min-chun. At present, sand dates have grown 2 meters high there. Beginning in 1953, three shelter forest belts of 5 li each were planted by Mao-tai village in Tu-me-te Banner in Wu Meng, Inner Mongolia, which greatly stabilized the drift sands there. In the future, the plan calls for the planting of seven large shelter forest belts in the desert areas in the Northwest which total 7,000 kilometers in length. Among them, the shelter forest belt in the corridor west of the Yellow River measures 1,700 kilometers.

Construction of sand dividers (or wind dividers) is also an effective measure of controlling the sands and protecting the growth of vegetation. There are two kinds of sand dividers. One kind is the dead (stabilized) sand divider. The divider is built with dead shrub stems and roots or with the stalks of farm crops, which are woven into nets to prevent the movement of the sands. In the past 8 years, a total of 1,500 dead sand dividers had been built in Min-chun, which protected the 40,000 mou of farm land against sand and wind storms. The western section of the Pao-lan Railroad passes through the southwestern border of Tseng-ke-li desert, where the construction of sand dividers, together with the growth of grasses and trees, has proved to be very effective. Another sand divider is called the live sand divider. The masses of I-ke-chao Meng transplanted aristemia to the sand hills. The rows of aristemia not only have the same effect as the dead sand dividers, but because the aristemia continues to grow, its effect lasts even longer. Better results can be achieved by the combination of building sand dividers and growing grasses.

2. Mechanical Measures. These measures include burying the sand under the soil, and the construction of dead and live sand dividers just mentioned. The method of burying the sand under the soil has been practiced by all hsien in the corridor west of the Yellow River. The method goes like this: the tops of the moving sand

hills are first leveled off, then covered by a layer of wet soil, clay, or grassy mud which is approximately 10-15 centimeters in thickness. After the layer is dry, it becomes a smooth and firm cover capable of minimizing wind depletion and beneficial to the growth of trees around the desert. In the past several years, this method has been practiced in Chin-ta to protect more than 2,000 mou of farm land. The sand protection barrage is made of a wooden frame, to which grates of wooden stripes, kaoliang stalks, mat-grass or reeds are attached. The barrage is placed on top of the sand hill to prevent the movement of the drift sands. According to the observation made at Sha-po-tao by the Sand Controlling Station of the Sino-Soviet Railroad, barrage made of mat-grass is the best. Wooden barrage is not only expensive, but would become crooked or bent down after having been exposed to the sun or wind. Moreover, lumber is in short supply in the Northwest. Kaoliang stalks are inexpensive, but are too weak and decay easily. Once the kaoliang barrage is filled up with sands, it cannot be pulled out for reuse. But the mat-grass barrage is strong, durable, and inexpensive and mat-grass can be easily obtained in the desert areas, thus making it the best material for constructing sand protection barrages. Generally speaking, the use of sand protection barrage is not economical enough. At present, the measure is used only to protect the basic construction in the areas in where sand control is urgently needed.

3. Hydraulic Measures. In addition to planting trees and growing grasses to stabilize the sands, irrigation measures have been adopted to improve the deserts into farmlands or grazing lands. The people in Yang-chiao-pan in Cheng-pan Hsien in northern Shensi and the people in Lai-lung-wan in Heng-shan Hsien have brought water from Lu Ho into the deserts in order to convert the sand hills into farm lands. In 1958, the people in Yu-lin Hsien built a canal in Yu-tung to let in the water from Hua-chu to the desert and finally to Cheng-chuan-pao. The canal is 280 li long and can irrigate 630,000 mou of farm land. During the construction, water was immediately brought in as soon as a section of the canal was completed. The water, in turn, was utilized to open up another section of the canal to stabilize the drift-sands. By these procedures, difficulties were overcome and the canal was finally completed. The people in Teng-kuo in Inner Mongolia adopted the same method to build 43 canals and turned the desert into 200,000 mou of farm land. All localities with similar conditions should take advantage of their experience and the underground and surface water resources should be surveyed and utilized to improve the deserts.

4. Agricultural Measures. Areas along the desert borders and the beaches within the deserts have better soils and have been reclaimed for agricultural production. These areas, due to the destruction of vegetation, can be easily turned into sand hills. To prevent the expansion of the sand hills, reclamation on the sand

hills must be prohibited. Farming activities on the reclaimed sand hills should be stopped, or shelter forests should be planted to protect the fields and stabilize the drift sands. It is extremely important to see to it that farming operations around the borders of the sand hills would not result in producing more sands, and at the same time, agricultural measures to protect the fields, such as growing kaoliang, corn, sunflower and other stalky crops, should be taken. After harvest, the stalks and stems of these crops could be utilized to hold up the sands. In addition, stones may be used to cover the ground right after sowing the seeds, so that the seeds may not be blown off.

The biological, mechanical, hydraulic, and agricultural measures just discussed all produce good effects in stabilizing the drift sands. But in order to make these measures more effective, sand-controlling surveys and programs must go hand in hand with them and experimental works must be strengthened. Experiments could be done in the field and the results of the experiments, once obtained, should be applied to production. When working out the sand-controlling programs, the characteristics of the natural conditions in various localities must be taken into consideration, so that the development of forestry, farming and animal husbandry can be well proportioned, and contradictions avoided. In the processes of enclosing the sand hills and growing grasses there, the grasses needed by the masses to feed their animals and for fuel purposes must be provided. A grazing rotation system should be established; that is, grazing should be done in various areas in rotation through the seasons; enclosure of sand hills should be undertaken one after another and the logging operations by the masses should be guided according to plans, so that they will not ruin the vegetation. Other problems such as propagation of young seeds and the allocation of the labor force are equally important and must be done in a balanced manner in order to assure the fulfillment of the various plans. This series of works can be accomplished only by the leadership of the local party organizations and by the reliance on the masses.